

Remarks

Claims 1, 2, 3, 7, 25, and 37, have been amended and claims 49-52 have been added. Each of claims 1, 25, and 37 now recite certain conditions of the process chamber, specifically providing that “at least a portion of the thermal curing occurs under anaerobic conditions.” This amendment finds support in the specification, particularly at page 20, lines 16-25, Example 1 at page 34, lines 29 and 30, and Example 2 at page 36, lines 31 and 32.

Claims 2, 3, and 7 have been amended to account for features incorporated into base claim 1.

Claims 49-52, dependant from claims 1, 24, 25, and 37, respectively, have been added to recite certain “anaerobic conditions” that can be achieved in the present invention. Specifically, claims 49-52 recite the feature “wherein the anaerobic conditions comprise less than 20 ppm oxygen.” This amendment finds support in the specification, particularly at Example 1 at page 34, lines 29 and 30 and Example 2 at page 36, lines 31 and 32. No fees are believed to be due with the addition of claims 49-52 because of the withdrawn claims previously paid for.

Claim rejections under 35 USC 103

Claims 1-37 stand rejected under 35 USC 103(a) as being obvious over Yang et al. (6,042,994) in combination with Yoshioka et al. (5,968,691) further in combination with Boas et al. (6,213,106).

Applicants overcome the rejection of independent claims 1, 25, and 37 because those claims have been amended to include the feature of providing anaerobic conditions during at least a portion of thermal curing. Applicants traverse the rejection of independent claim 24 because that claim recites the feature of providing anaerobic conditions during at least a portion of thermal curing. The rejection of independent claim 14 is traversed because it recites a feature related to repeating/controlling the time period at least between pre-baking and thermal curing and the rejection of independent claim 23 is traversed because it recites a feature related to a pre-baked dielectric composition having at least a portion of uncured dielectric precursor and a residual amount of solvent. These specific, patentably significant features of claims 1, 14, 23, 24, 25, and 37, singly or in combination, are nowhere shown in any of the cited references. Because the cited references fail to even remotely suggest the above claimed features of claims 1, 14, 23, 24, 25, and 37, singly or in combination, the rejection cannot stand.

Inventive step is significant by teaching integrating both thermal curing and post-cure, in situ cooling into the same process station in combination with anaerobic conditions.

Independent claims 1, 24, 25, and 37 teach controlling the oxygen level during at least a portion of the thermal curing in forming a cured, dielectric precursor. This is important, because many dielectric precursors as well as the resultant dielectric films are susceptible to thermal oxidation at elevated temperatures in the presence of oxygen. Because dielectric precursors are generally cured at elevated temperatures, the substrates bearing these materials are desirably maintained in an anaerobic environment so long as the substrates are hot enough for thermal oxidation to be an undue risk (e.g., during at least a portion of thermal curing).

To aid in overcoming the technical challenge of providing such an anaerobic environment, Applicants discovered that such an environment could be promoted by integrating both thermal curing and post-cure, in situ cooling into the same process station in combination with anaerobic conditions. The thermal curing and post-cure, in situ cooling feature avoids potential aerobic transfer between conventional, separate thermal cure and chill stations. Claims 1, 25, and 37 have been amended to recite “at least a portion of the thermal curing occurs under anaerobic conditions” so that this combination of features is now claimed in those claims. Claim 24 already recites this combination. Claim 1 is exemplary and recites this inventive combination of features as follows:

[W]hile the coated substrate is positioned in the process chamber: (i)thermally curing the dielectric precursor to form the cured dielectric composition; and (ii)causing a gas to coolingly contact the cured dielectric composition, wherein at least a portion of the thermal curing occurs under anaerobic conditions

The primary reference, Yang et al., fails to teach or suggest the claim features of integrating both thermal curing and post-cure, in situ cooling into the same process station in combination with providing anaerobic conditions during at least a portion of the thermal curing. Indeed, Yang et al. would not and could not have suggested this claim feature because Yang et al. describe that electron beam curing is better than thermal curing and direct a skilled worker away from any further work in the area of thermal curing.

Also, the primary reference, Yang et al., even fails to teach or suggest the single claim feature of integrating both thermal curing and post-cure, in situ cooling into the same process station.

The secondary references, Yoshioka et al. and Boas et al., fail to cure these significant deficiencies of the Yang et al. reference.

Yoshioka et al. fail to teach the claim features of integrating both thermal curing and post-cure, in situ cooling into the same process station in combination with providing anaerobic conditions during at least a portion of the thermal curing. Moreover, Yoshioka et al. involves baking photoresist, not curing dielectric precursors. Being in a different technical regime, how can it be proper to extract details from the Yoshioka et al. reference and plug them into the Yang et al. reference absent hindsight? Yoshioka et al. would not have suggested, absent Applicants' specification, the claimed combination of integrating both thermal curing and post-cure, in situ cooling into the same process station with providing anaerobic conditions during at least a portion of the thermal curing.

The other secondary reference, Boas et al., fails to cure the deficiencies of the primary reference, Yang et al, and/or the Yoshioka et al. reference.

Boas et al. fail to teach the claim features of integrating both thermal curing and post-cure, in situ cooling into the same process station in combination with providing anaerobic conditions during at least a portion of the thermal curing. Moreover, Boas et al. would not have suggested this claimed combination of features. The Boas et al. reference focuses on controlling the rate of heat transfer between a substrate and a thermal reservoir for thermal processes in general. (See, Boas et al. at the Abstract and Background of the Invention). Boas et al. do not specifically describe thermal curing of dielectric precursors. ~~Absent Applicants' specification, the Boas et al. reference would not have suggested the~~
claimed combination of integrating both thermal curing and post-cure, in situ cooling into the same process station with providing anaerobic conditions during at least a portion of the thermal curing.

Also, Yoshioka et al. and Boas et al., alone or in combination, even fail to teach or suggest the single claim feature of integrating both thermal curing and post-cure, in situ cooling into the same process station. Indeed, the Office Action appears to agree that the Yoshioka et al. fails to teach or suggest this feature by stating its reliance on the Boas et al. reference for this feature. See the Office Action at page 3. As described above, the Boas et al. reference focuses on controlling the rate of heat transfer between a substrate and a thermal reservoir for thermal processes in general. Absent Applicants' Application, the Boas et al. would not have suggested to incorporate any of their teachings into thermal curing of dielectric precursors, or more specifically, the claim feature of integrating both thermal curing and post-cure, in situ cooling into the same process station.

Even further, even if the Yoshioka et al. and/or the Boas et al. references did specifically relate to thermal curing of dielectric precursors, there would have been no motivation to modify the Yang et al. reference with the Yoshioka et al. or Boas et al. references, alone or in combination, because Yang et al. describe that electron beam curing is better than thermal curing which directs a skilled worker to abandon thermal curing in favor of electron beam curing.

Because the primary reference, Yang et al., alone or in combination with one or more secondary references, Yoshioka et al. and Boas et al., fails to teach or suggest the feature in claims 1, 24, 25, and 37 of integrating both thermal curing and post-cure, in situ cooling into the same process station and fail to teach or suggest such integrated thermal curing/in-situ cooling in combination with providing anaerobic conditions during at least a portion of the thermal curing, the Office Action has not met its burden of establishing a prima facie case of obviousness with respect to independent claim 24 and its associated dependant claims and a prima facie case of obviousness does not exist with respect to independent claims 1, 25, and 37, and the associated dependant claims.

Claim 14 is even more patentable by teaching to control the time period at least between pre-baking and thermal curing in forming a cured, dielectric precursor.

~~Claim 14 recites a feature related to repeating/controlling the time period at least~~
between pre-baking and thermal curing. Controlling such a time period can greatly enhance the throughput, uniformity, and quality of low-k dielectric films. This is an extremely significant result! See the specification at, for example, page 4, line 27 to page 5, line 2.

Specifically, claim 14 recites the feature:

- (b) causing the coated substrate to be prebaked ...;
- (c) causing the coated substrate to be thermally cured, said thermal curing being initiated after a second time interval from the end of the pre-baking step...
- (e) repeating steps (a) through (d) for at least one additional substrate, wherein the respective second time intervals for each of the first coated substrate and the at least one additional coated substrate are substantially the same.

This feature recited in claim 14 is absolutely not shown in any cited reference. The primary reference, Yang et al., is completely silent with respect to this feature and would not have even remotely suggested this claim feature because Yang et al. describe that

electron beam curing is better than thermal curing and direct a skilled worker to abandon any further work in the area of thermal curing in favor of electron beam curing.

The secondary references, Yoshioka et al. and Boas et al., fail to remedy the shortcomings of the Yang et al. reference.

The secondary reference, Yoshioka et al., fail to teach the feature in claim 14 related to repeating/controlling the time period at least between pre-baking and thermal curing and would not have suggested this claim feature because Yoshioka et al. relate to baking a photoresist solution, not thermally curing a dielectric precursor.

The other secondary reference, Boas et al., fails to cure the deficiencies of the Yang et al. and/or the Yoshioka et al. references. Boas et al. fail to teach the feature in claim 14 related to repeating/controlling the time period at least between pre-baking and thermal curing and would not have suggested that claim feature because Boas et al. focus on the rate of heat transfer between a substrate and a thermal reservoir for thermal processes in general and do not express any need to repeat/control the time period at least between pre-baking and thermal curing in a thermal curing process.

Even further, even if the Yoshioka et al. and/or the Boas et al. references did specifically relate to thermal curing of dielectric precursors, there would have been no motivation to modify the Yang et al. reference with the Yoshioka et al. or Boas et al. references, alone or in combination, because Yang et al. describe that electron beam curing is better than thermal curing which directs a skilled worker to abandon thermal curing in favor of electron beam curing.

Because the primary reference, Yang et al., alone or in combination with one or more secondary references, Yoshioka et al. and Boas et al., fails to teach or suggest the feature in claim 14 that teaches to repeat/control the time period at least between pre-baking and thermal curing, the Office Action has not met its burden of establishing a *prima facie* case of obviousness with respect to independent claim 14 and its associated dependant claims.

Claim 23 is also even more patentable by teaching to have at least a portion of uncured dielectric precursor and a residual amount of solvent in a pre-baked dielectric composition.

Claim 23 recites a feature related to a pre-baked dielectric composition having at least a portion of uncured dielectric precursor and a residual amount of solvent. This feature of the present invention significantly results in more uniform thermally cured dielectric films and better correlation between dielectric precursor and the resultant thermally cured dielectric film (See, the specification at page 30, lines 15-31).

The primary reference, Yang et al., fails to teach this claim feature and would not have even remotely suggested this claim feature because Yang et al. describe that electron beam curing is better than thermal curing and direct a skilled worker to abandon any further work in the area of thermal curing in favor of electron beam curing.

The secondary references, Yoshioka et al. and Boas et al., fail to remedy the shortcomings of the Yang et al. reference.

The secondary reference, Yoshioka et al., fail to cure this deficiency of the Yang et al. reference. Yoshioka et al. fail to teach and would not have suggested this claim feature because Yoshioka et al. relate to baking a photoresist solution, not thermally curing a dielectric precursor.

~~The other secondary reference, Boas et al., also fails to cure this deficiency of the~~
Yang et al. reference and/or the Yoshioka et al. reference. Boas et al. fail to teach and would not have suggested this claim feature because Boas et al. focus on controlling the rate of heat transfer between a substrate and a thermal reservoir for thermal processes in general, not thermally curing dielectric precursors.

Even further, even if the Yoshioka et al. and/or the Boas et al. references did specifically relate to thermal curing of dielectric precursors, there would have been no motivation to modify the Yang et al. reference with the Yoshioka et al. or Boas et al. references, alone or in combination, because Yang et al. describe that electron beam curing is better than thermal curing which directs a skilled worker to abandon thermal curing in favor of electron beam curing.

Because the primary reference, Yang et al., alone or in combination with one or more secondary references Yoshioka et al. and Boas et al., fails to teach or suggest the feature in claim 23 related to a pre-baked dielectric composition having at least a portion of

uncured dielectric precursor and a residual amount of solvent, the Office Action has not met its burden of establishing a *prima facie* case of obviousness with respect to independent claim 23 and its associated dependant claims.

In conclusion, Applicants request that the rejection of independent claims 1, 14, 23, 24, 25, and 37 and their associated dependant claims (i.e., claims 1-37) under 35 USC 103(a) as being obvious over Yang et al. in combination with Yoshioka et al. and further in combination with Boas et al. be withdrawn.

Improper Rejections

Applicants repeat the request that the rejection independent claims 14, 23, and 24, and their dependant claims, and dependant claims 4, 5, 6, 7, 19, 20, and 21, under 35 U.S.C. 103(a) as being obvious over Yang et al. in combination with Yoshioka et al. further in combination with Boas et al. be withdrawn on grounds that they have been improperly rejected. As support for this request, Applicants consider 37 C.F.R. 1.104(c)(2), which states:

In rejecting claims for want of novelty or for obviousness, the examiner must cite the best references at his or her command. When a reference is complex or shows or describes inventions other than that claimed by the applicant, the particular part relied on must be designated as nearly as practicable. The pertinence of each reference, if not apparent, must be clearly explained and each rejected claim specified (Emphasis added).

Applicants described at page 9 in Applicants' previous Response filed November 27, 2002, that the Yang et al., Yoshioka et al., and Boas et al. references describe complex inventions.

Both the previous Office Action, mailed June 28, 2002 and the present Office Action reject all of claims 1-37 as obvious over Yang et al. in combination with Yoshioka et al. further in combination with Boas et al. However, because the Office Action does not even address or mention many significant claim features, especially in certain independent claims, it is not apparent from either Office Action, how or where the cited Yang et al. reference renders obvious, alone or in combination with the Yoshioka et al. and Boas et al. references, critical features in the claims.

For example, the previous and present Office Actions do not even remotely address the claim feature in independent claim 14 related to repeating/controlling the time period between pre-baking and thermal curing or the claim feature independent claim 23 related to a pre-baked

dielectric composition having at least a portion of uncured dielectric precursor and a residual amount of solvent. These features are clearly recited in the claims and have been highlighted by Applicants as patentably significant in both the previous and present Response.

In addition, neither the previous nor the present Office Action address the anaerobic features recited in, for example, independent claim 24 and dependant claims 4, 5, 6, 7, 19, 20, and 21. The significance of this feature is clearly addressed above and has been incorporated into amended independent claims 1, 24, 25, and 37 to highlight its patentable significance.

Because the pertinence of the cited references is not apparent from the previous or present Office Actions and the particular part of each reference relied on by the Office Action is not clearly explained in either Office Action, the rejection of claims 1-37 as obvious over the cited references is improper.

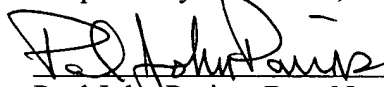
Accordingly, Applicants respectfully request that the outstanding rejection of independent claims 14, 23, and 24, and their dependant claims, and dependant claims 4, 5, 6, 7, 19, 20, and 21, under 35 USC 103(a) as being obvious over Yang et al. in combination with Yoshioka et al. and further in combination with Boas et al. be withdrawn.

Conclusion

In view of the above amendment and remarks, it is respectfully submitted that the claims ~~and the present application are now in condition for allowance. Approval of the application and~~ allowance of the claims is earnestly solicited. In the event that a phone conference between the Examiner and the Applicant's undersigned attorney would help resolve any remaining issues in the application, the Examiner is invited to contact said attorney at (651) 275-9831.

Dated: 6/30/03

Respectfully Submitted,



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